AGE DETERMINATION AND GROWTH OF *DISSOSTICHUS MAWSONI* (NORMAN, 1937) (PISCES, NOTOTHENIIDAE) FROM McMURDO SOUND (ANTARCTICA)

by

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ABSTRACT. – Age determination of *Dissostichus mawsoni* from otoliths (which has previously been difficult) was made possible by the use of a thin sectioning technique. From counts of annular increments, the specimens sampled were of age classes 7 to 31 years. The regression of weight on length was $W_f = 2.25 \times 10^{-5} \times L_t^{2.916}$, where length is in millimetres and weight is in grams. A fitted growth curve using a non-linear weighted least squares technique was estimated as $L_t = 1852\ (1-e^{-0.056\ (t-(-4.73))})$, where L_t is in millimetres and t is time in years.

RESUME. – La détermination de l'âge de *Dissostichus mawsoni* à partir des otolithes (méthode difficilement utilisable jusqu'à présent) a été rendue possible par l'utilisation d'une technique de sections fines. A partir du comptage des annuli, les spécimens échantillonnés ont été placés dans les classes d'âge 7 à 31 ans. L'équation reliant le poids et la longueur est $W_f = 2.25 \times 10^{-5} \times L_t^{2.916}$, où la longueur est exprimée en millimètres et le poids en grammes. La courbe de croissance ajustée par la méthode des moindres carrés a pour équation :
$L_t = 1852\ (1-e^{-0.056 (t-(-4.73))})$, où L_t est en millimètres et t en années.

Mots-clés : PSE Antarctica, Nototheniidae, Dissostichus mawsoni, age determination, growth.

This paper reports on the age-length composition and growth of *Dissostichus mawsoni*. The biology of this species is not well understood and there is little published information on its age and growth. Until now, information from the middle years of *D. mawsoni* has been lacking, and the knowledge of *D. eleginoides* is almost entirely based upon juveniles.

Ecological studies of *D. mawsoni* have been carried out by Yukov (1970, 1971 and 1972), who studied aspects of distribution, feeding behaviour, reproduction and otolith structure. He reported that *D. mawsoni* was confined to the circum-antarctic waters south of the Antarctic Convergence with northernmost records at about 57° S in the Indian and Atlantic sectors.

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MATERIALS AND METHODS

Specimens of *D. mawsoni* covering a wide size range were collected from McMurdo Sound (Antarctica) between 1975 and 1980. Sampling was carried out using hooks and lines through holes cut in the sea ice. Fish were weighed and measured and the pair of sagittal otoliths removed from each specimen. The otoliths were dried and stored in labelled envelopes for later examination. Otoliths were processed using a technique developed by Bedford (1983). The otoliths were orientated the same way in rows with the nuclei aligned and were embedded in black polyester resin. Thin sections were then cut through the nuclei of the rows of otoliths using a high speed diamond saw. This technique has been successfully used on otoliths of the Antarctic fish, *Notothenia rossii marmorata* by M.S. Burchett.

Initially, the large size of the otoliths, compared to those of *N. rossii*, made sectioning of polyester resin mounts difficult because of the tendency for the otoliths to crack and break out of the mounting medium. However, careful cutting and increased lubrication overcame these difficulties.

The embedded thin sections of otoliths were mounted and fixed on standard microscope slides using clear polyester resin and the section examined under a binocular microscope using x 6 and x 100 magnification. Both transmitted and reflected light were used to assist with the identification of the annular rings.

RESULTS AND DISCUSSION

Otoliths Examination. The sections showed clear annular rings (Fig. 1). However, care was needed in the interpretation of the annuli as they become considerably compressed in the older fish. Large otoliths had an easily recognisable nucleus with seven to eight large annuli, followed by narrower and more regular annuli, suggesting maturity at about eight years of age. The appearance of the first spawning zone at about eight years of age corresponds to a total length of between 950 and 1050 mm for *D. mawsoni* sampled at McMurdo Sound. In the congener species, *Dissostichus eleginoides*, the first spawning zone is found at about seven to eight years which corresponds to a standard length of about 400 mm for fish from Iles Kerguelen (Hureau and Ozouf-Costaz, 1980).

Length-weight Relationship. Using the length and weight data from 52 specimens of *D. mawsoni* ranging in size from 860 to 1620 mm, a log length against a log weight regression was détermined. The equation for the conversion of length to weight was found : $W_f = 2.25 \times 10^{-5} \times L_t^{2.916}$ $(r = 0.96)$, where W_f is the fresh weight in grams and l_t is the total length in millimetres.

Growth Curve. A Von Bertalanffy growth curve of length against age for *D. mawsoni* was fitted using a non-linear weighted least squares technique with the residuals for each age class weighted by $\sqrt{n} \;/\; \bar{l}_t$, where n is the sample size and l_t is the mean total length in each age class. The mean lengths used in the calculations and estimated fitted lengths obtained for each age class are presented in

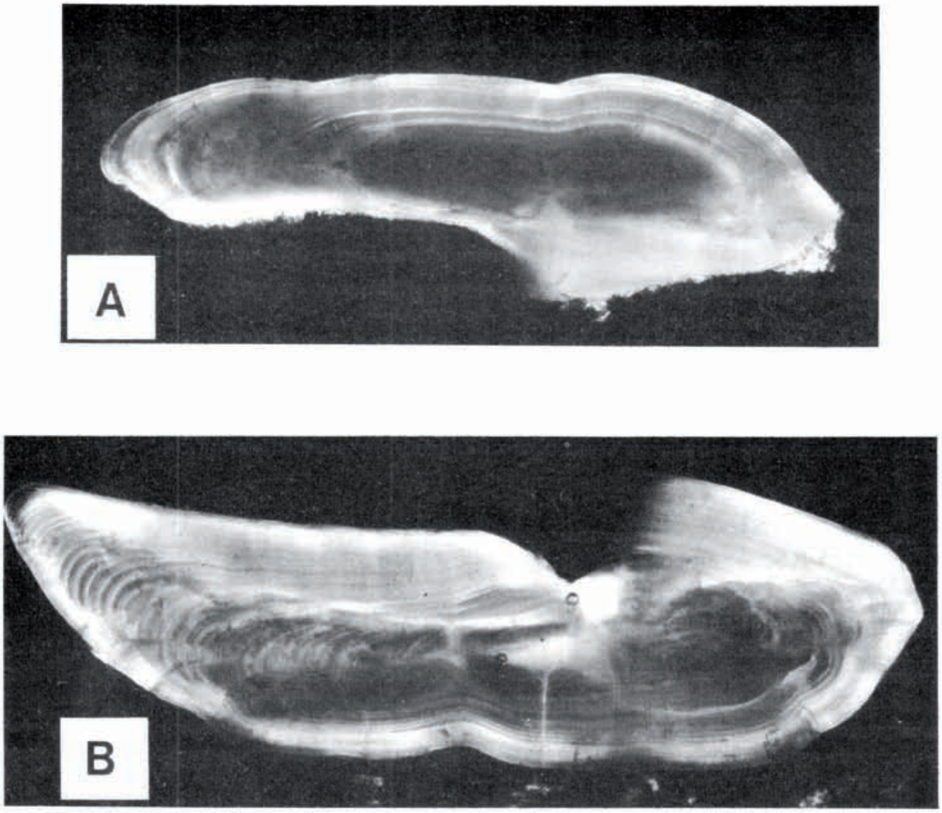

Fig. 1. – Transverse sections of otoliths of selected age classes of *Dissostichus mawsoni* sampled at McMurdo Sound. (A : age class VII, otoliths 5 mm long ; B : age class XXXI, otolith 8 mm long).

Table I. The growth parameters were estimated to be : $L_\infty = 1852$ mm, $K = 0.056$ and $t_o = -4.73$ years ($r = 0.98$). The growth parameters were substituted in the expression :

$$L_t = L_\infty \ (1 - e^{-K(t-t_o)}).$$

Hence the growth equation for *D. mawsoni* was :

$$L_t = 1852 \ (1 - e^{-0.056(t-(-4.73))}).$$

The data points for the individual specimens and the fitted curve are presented in Fig. 2.

CONCLUSION

Age determination of Antarctic fish is now well established largely as a result of methods described in the Reports of the First and Second BIOMASS Workshops on the Ageing of Antarctic Fishes (Everson, 1981, DeWitt, 1982). Age determination using the technique of charring the otoliths is widely practiced. However,

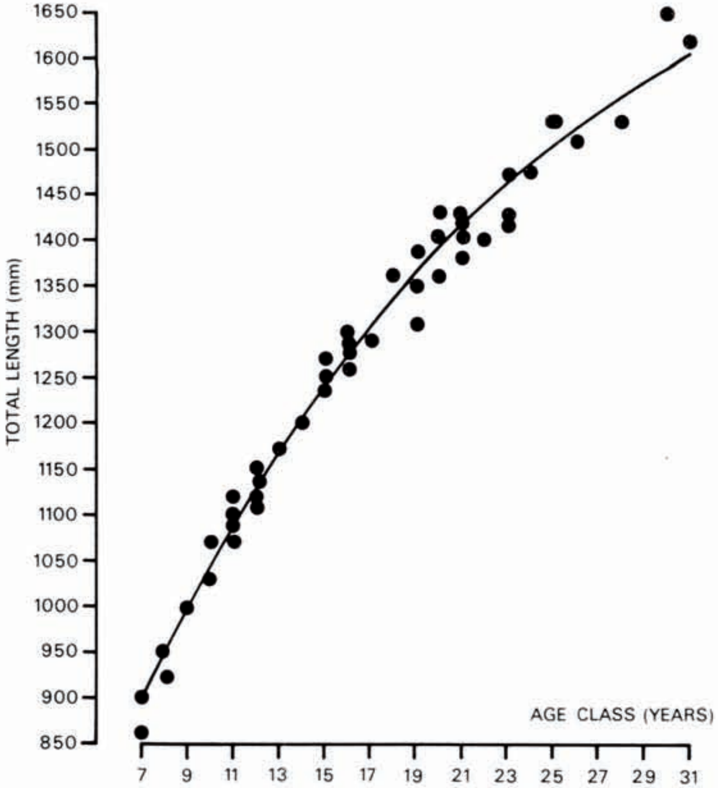

Fig. 2. – Length (mm) plotted against age (years) for each specimen and fitted Von Bertalanffy growth curve for *Dissostichus mawsoni* sampled at McMurdo Sound.

D. mawsoni had presented the most difficult problems in ageing because of its long life and slow growth as an adult.

Kock (pers. comm.) reports that *D. mawsoni* should be one year older than is estimated from scale interpretation. This is because scales are not produced until the fish have reached a length of about 66 mm. Yukhov (1971) found specimens of *D. mawsoni* having a length range of 185 to 1740 mm and weight range of 179 to 80 000 g (n = 32). He found the length of the longitudinal and transverse diameters of the whole otoliths varied in mature fish from 9.4 to 12.0 mm and from 7.0 to 8.0 mm respectively. The sizes of fish and their otoliths used in this paper cover much of this size range. Therefore, the range in size of the fish can be considered representative for the purpose of age and growth determination of adults, and the estimated L_∞ of 1852 mm reasonable, given a reported maximum length of 1740 mm for *D. mawsoni* (Yukhov, 1971).

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TABLE I. – Mean lengths (mm) and fitted lengths (mm) of ***Dissostichus mawsoni*** from Mc Murdo Sound (Antarctica).

Age Class	$\overline{L_t}$	Fitted lengths	n
7	880	894	2
8	935	946	2
9	1 000	996	1
10	1 050	1 043	2
11	1 093	1 087	4
12	1 134	1 129	5
13	1 170	1 168	1
14	1 200	1 206	1
15	1 250	1 241	3
16	1 280	1 274	4
17	1 290	1 306	1
18	1 360	1 336	1
19	1 363	1 364	4
20	1 395	1 391	2
21	1 407	1 416	3
22	1 400	1 440	1
23	1 437	1 462	3
24	1 480	1 484	1
25	1 530	1 504	1
26	1 510	1 523	1
27	–	1 541	0
28	1 530	1 558	1
29	–	1 574	0
30	1 650	1 589	1
31	1 620	1 603	1

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